# System Safety Grounding Procedure

**DOCUMENT IDENTIFIER:** A-SP-ELMF300-00-0000 Rev A1, 28-Feb-1991

**ABSTRACT:** Describes the methods used by the Technical Services for Manufacturing and Engineering (TME) Group to provide proper safety grounding for all system components cabinets.

**APPLICABILITY:** The safety ground connection methods and procedures described in this specification are mandatory for use on painted and plated cabinet structures and components

**STATUS:** APPROVED 28-Feb-1991; use VTX SMC for current status.

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APPROVAL: This document has been recommended for approval by the General Review group for its category. The A1 revision is an update with clerical changes only

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# 1 INTRODUCTION

## 1.1 PURPOSE

This procedure describes the methods and procedures to be used by Technical Services for Manufacturing and Engineering (TME) to ensure the proper safety grounding of all system components and cabinets. Proper safety grounding is vital to protecting operators and service personnel from electrical shock hazards.

## 1.2 SCOPE

This document differentiates the various methods of safety grounding required for painted or plated cabinet structures and components.

## 1.3 DEFINITIONS

For the purpose of this procedure, the following definitions have been adopted:

**Earth ground -** A conducting connection, or part thereof, between an electric circuit or equipment and earth reference.

**Safety ground -** A safety connection referred to as frame ground, hardware ground, protective ground, or earth ground.

**Earth leakage current -** Leakage current flow in the safety ground circuit(s).

**Performance ground -** The collection of electrical connections and conductors within a system for the primary purpose of enhancing signal integrity to the end of optimizing the operation of the system.

# 2 REQUIREMENTS

a. All conductive parts that a person could touch and that might become energized by an equipment failure in the primary power system shall be connected together and to earth ground.

b. A safety ground connection shall be an electrical connection and shall not contain a device capable of interrupting its connection or circuit continuity (for example, a switch, fuse, circuit breaker, and such).

c. It shall not be permissible to ground several pieces of equipment or components using a daisy chain connection. By removing any component in the chain, it will leave the other components ungrounded.

d. Hardware used to make safety ground connections shall require tools for removal.

e. All safety ground wires and hardware must be a size at least as large as the conductor carrying the load current for the device.

f. All safety ground connections using threaded hardware fasteners shall be torqued to a specified setting.

g. The safety ground wire shall not carry normal load currents.

h. Hardware used for grounding shall be exclusively used for that purpose. This hardware shall not be used as a mechanical fastener to hold two pieces of equipment or components together.

## 2.1 SAFETY GROUND WIRE COLOR AND MARKINGS

If the safety ground is a stranded insulated wire, it must be color coded green with a yellow stripe, where neither stripe shall occupy less than 30%, nor more than 70%, of the surface of the insulation. These colors are reserved for safety grounding.

Braided bare wire with clear insulation may also be used as a safety ground wire.

Ground wires that are used exclusively to enhance system operation, such as radio frequency shields or connections, shall be green, not the green/yellow color code. Braided conductors may also be used and shall have a transparent coating.

In a free-standing device, such as an RA80 in a CPU cabinet, a separate safety ground wire is not required. In these types of products, the safety ground is the power cord.

## 2.2 GROUNDING HARDWARE

The safety ground wire shall be secured to the frame or chassis by non-ferrous or plated hardware. All hardware used for safety grounding shall be free of all (conductive or non-conductive) paint.

## 2.3 GROUNDING SURFACE

### 2.3.1 Painted Cabinets and Components

The surface provided for grounding shall be through stainless steel stand-offs and studs, or copper-flashed mild steel weld studs.

### 2.3.2 Plated or Conductive Painted Cabinets and Components

Ground wires shall be attached directly to plated and conductive cabinets using proper hardware stack-ups (see Section 6, Ground Connection Methods). Studs and stand-offs may also be provided for design considerations.

## 2.4 PERFORMANCE GROUNDING

Grounding for special signal considerations is not required for personal safety.

Where customer installation requires a physical separation of system cabinets, and a performance wire is required between both units (for example, Massbus signal integrity), the green/yellow wire color is not allowed, because each cabinet is independently grounded using the incoming power cord.

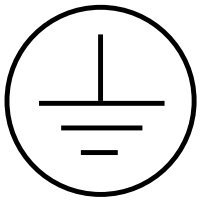
This also applies to remote free-standing peripherals (such as RK06, LP05, terminals, or card readers) where the safety ground system is the safety ground conductor of the ac power cord. Power for remote peripherals SHOULD NOT come from a system power controller. Power outlets should be on the same ground as the system. This is of particular importance at facilities that have an instrumentation grounding system, in addition to the normal building power ground system.

# 3 GROUND TERMINAL IDENTIFICATION

## 3.1 SAFETY GROUND TERMINAL

The safety ground terminal to which the green/yellow wire in the main power cord is connected shall be marked by the ground symbol within a circle. Refer to Figure 1.

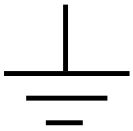
**Figure 1: Ground Symbol Within a Circle**



## 3.2 OTHER ELECTRICAL TERMINALS

All other electrical ground terminals, with the exception of the neutral connection, can be marked by the ground symbol without the circle. Refer to Figure 2.

**Figure 2: Ground Symbol**



## 3.3 GROUND SYMBOL DECALS

For ground symbol decals, refer to Digital part numbers 36-12608-00 or 36-12372-00.

# 4 HARDWARE

## 4.1 CONNECTIONS

It is necessary that all connections be permanent and not be become loose without the use of tools. These connections shall be secured using locking devices such as split lock washers, internal lock washers (for external finished surfaces), external lock washers, serrated head screws, sems screws, and Kep nuts.

## 4.2 THREAD CONTACT

It is required that the thread contact of a screw, stand-off, or nut be a minimum of two threads.

# 5 TOOLS

## 5.1 GROUND WIRE CONNECTIONS

These screwdrivers should be internally calibrated to the proper torque recommended by EL-MF328-00, *Engineering Specification - General Torque Requirements,* for the hardware being used. (previously A-SP-7665328-0-0)

**NOTE**

**It is recommended that all connections for ground wires be made using pneumatically or electrically-powered screwdrivers.**

## 5.2 HAND TORQUE TOOLS

Hand torque tools, such as dial/gauge or break-away, may be used when warranted. These hand tools or screwdrivers should be calibrated to the torque recommended in EL-MF328-00 for the hardware being used. Refer to Figure 3.

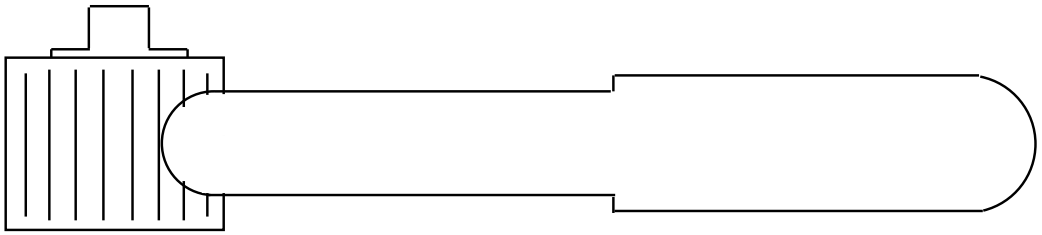
**NOTE**

**It is not acceptable to use a common screwdriver for this assembly.**

## 5.3 CALIBRATED SCREWDRIVERS

All screwdrivers used for ground wire assembly shall be calibrated monthly. At that time, a calibration sticker or marking shall be affixed to the tool, showing date of calibration, torque setting, location where calibration was performed, and either a signature or stamp of the technician who performed the calibration.

**Figure 3: Breakaway Torque Wrench Tool Number NC100**



Recommended Supplier:
Seekonk Manufacturing Company
Perrin Avenue
Seekonk, MA 02771

The breakaway torque wrench recommended for QC shall be set at 80% of required torque for the hardware used. Assembly should use pneumatic- or electric-powered torque-controlled screwdriver.

## 6 GROUND CONNECTION METHODS

For the purpose of illustration, typical hardware is used. The exact hardware to be used will be specified in the engineering drawings and parts lists.

When the torque requirements are not specified in the engineering drawing, refer to EL-MF328-00 for correct torque values.

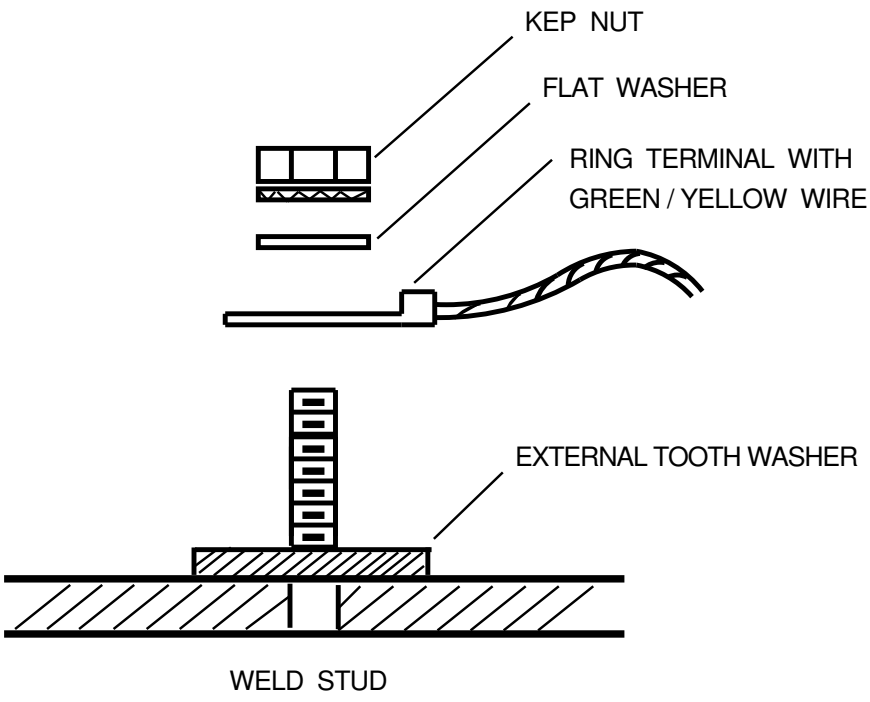
## 6.1 PAINTED CABINETS AND CHASSIS

### 6.1.1 Weld Stud Ground Connections

Refer to Figure 4.

1. Make sure the stud is clean and free of all paint and foreign material. Clean it, if necessary.
2. Place lock washer next to surface.
3. Place ground wire ring terminal on the stud.
4. Add flat washer on the stud, on top of the ring terminal.
5. Secure by using lock washer and nut, or a Kep nut.
6. Tighten using proper tools and torque to the specified requirements.

**Figure 4: Weld Stud**

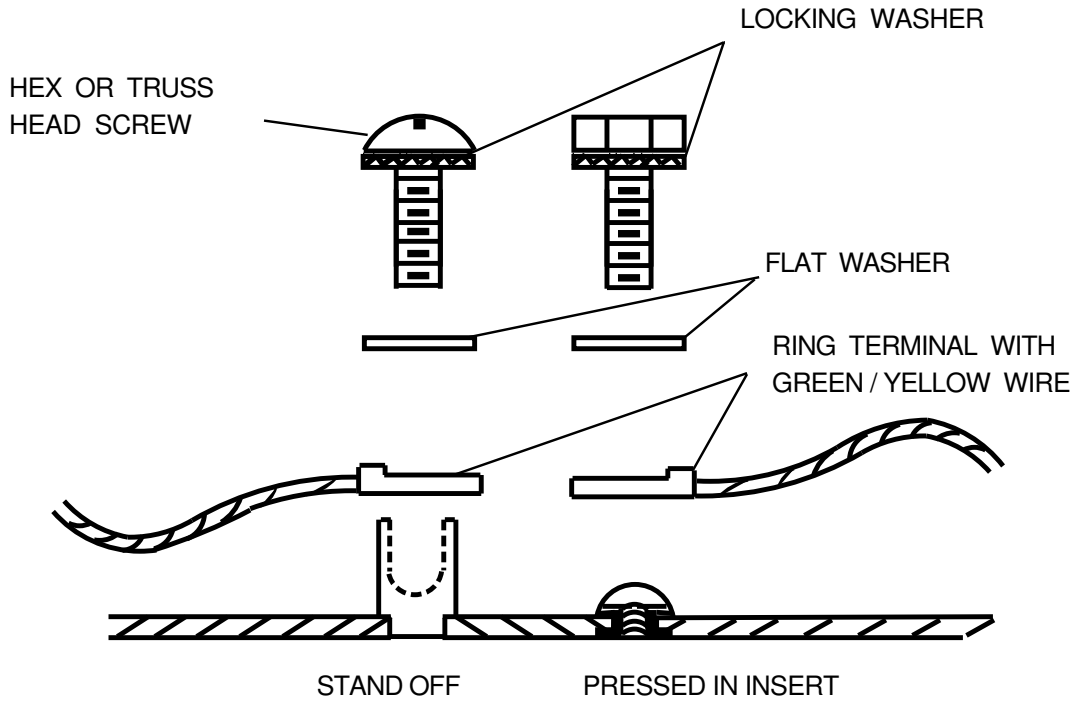


### 6.1.2 Press Nuts and Stand-Offs

Refer to Figure 5.

1. Make sure that the press nut or stand-off is clean and free of all paint and foreign material. Clean it, if necessary.
2. 
   a. Using sems screw or serrated head, place flat washer on screw.
   b. Using standard screw, place lock washer on screw, then place flat washer on screw.
3. Place ground wire ring terminal on screw.
4. Add flat washer and ground wire into insert.
5. Tighten using proper tools and torque to the specified requirements.

**Figure 5: Inserts and Stand-offs**



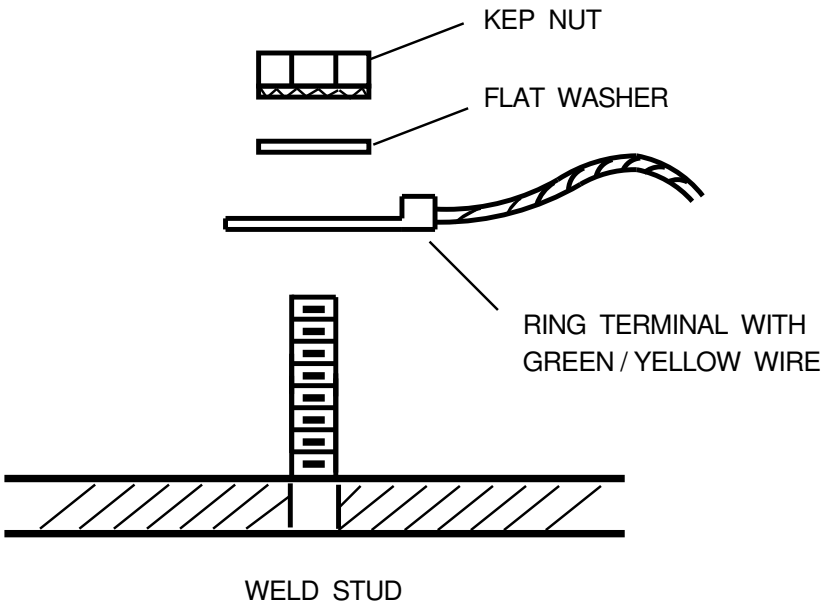
## 6.2 CONDUCTIVE PAINT AND PLATED CABINETS AND CHASSIS

### 6.2.1 Weld Stud Ground Connections

Refer to Figure 6.

1. Make sure the stud is clean and free of all paint and foreign material. Clean it, if necessary.
2. Place ground wire ring terminal on the stud.
3. Add flat washer on the stud, on top of the ring terminal.
4. Secure by using lock washer and nut, or a Kep nut.
5. Tighten using proper tools and torque to the specified requirements.

**Figure 6: Weld Stud**



## 6.3 PLATED CABINETS AND CHASSIS

### 6.3.1 Captive Nut, "U" Nut (Tinnerman)

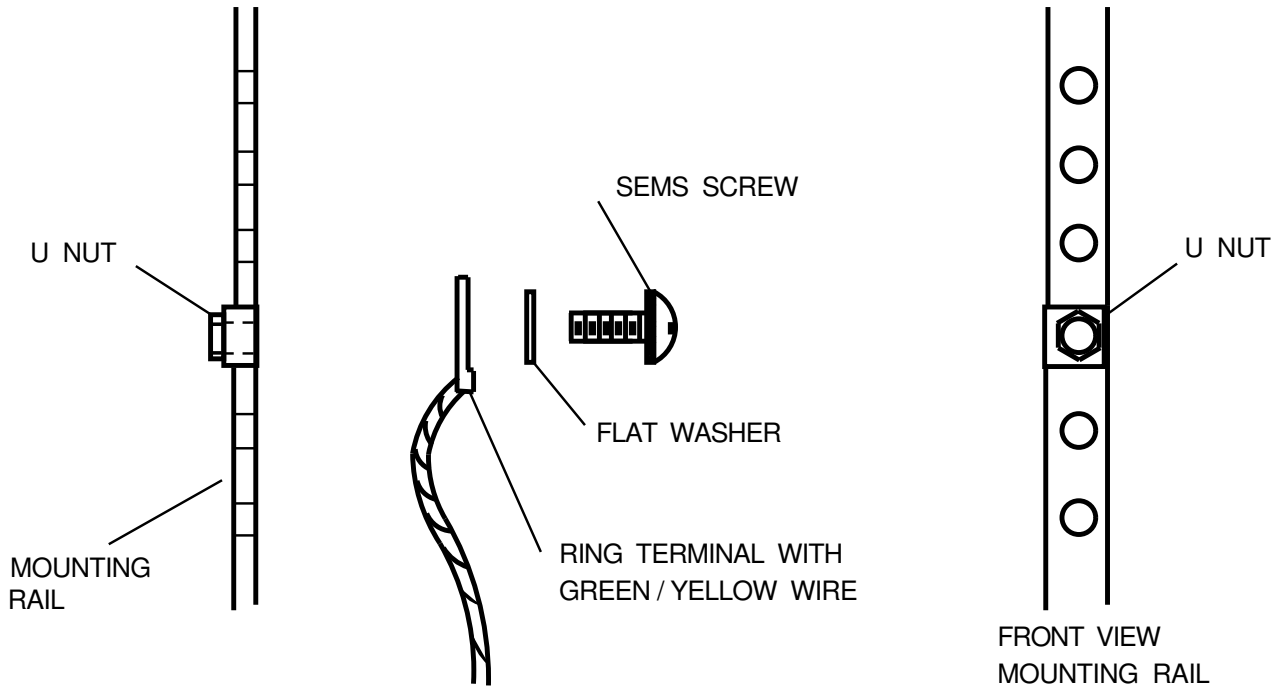
Refer to Figure 7.

1. Place U-nut on to rail.
2. 
   a. Using serrated head screw or sems screw, place flat washer on screw.
   b. Using standard screw, place lock washer on screw, then place flat washer on screw.
3. Place ground wire ring terminal on screw.
4. Assemble hardware and ground wire into "U" nut.
5. Tighten the assembly using proper tools and torque to the specified requirements.

**NOTE**

**Thread contact must be at least two threads within the U-nut.**

**Figure 7: "U" Nut Retainer**



### 6.3.2 Clearance Hole

Refer to Figure 8.

1.
   a. Using serrated head screw or sems screw, place flat washer on screw.
   b. Using standard screw, place lock washer on screw, then place flat washer on screw.
2. Place ground wire ring terminal on screw.
3. Place assembly screw through clearance hole and secure using either a Kep nut, or a hex nut and a lock washer.
4. Tighten the assembly using the proper tool and torque to the specified requirements.

**Figure 8: Metal Clearance Hole**

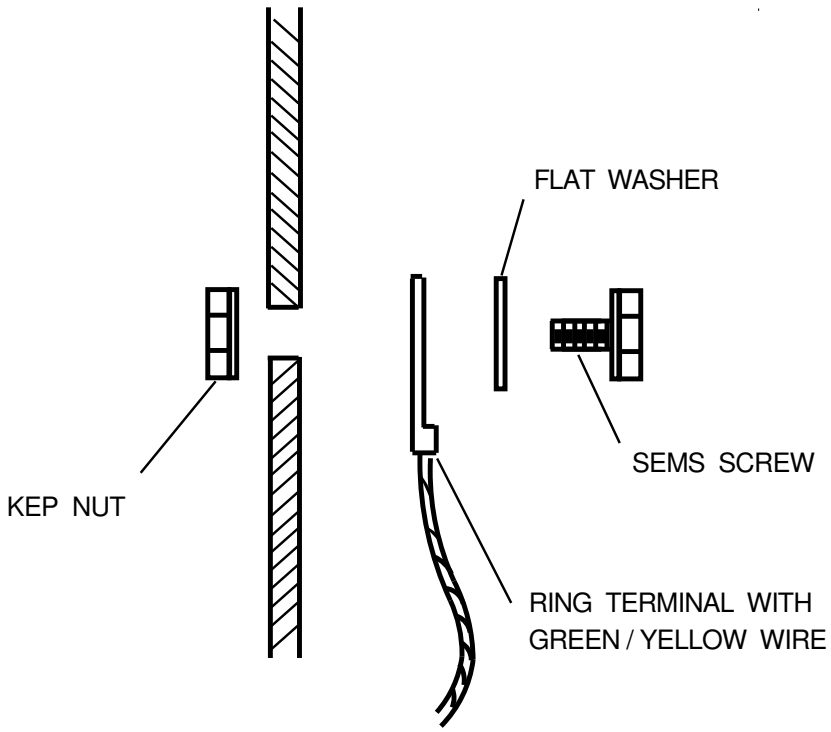


**Table 1: Recommended Nuts and Screwdrivers**

| Thread Size | Torque Range (in. lbs) | Handle | Clutch | Tool Number | Manufacturer |
|---|---|---|---|---|---|
| 2 - 56 | 1 - 21 | Straight | Push to Start | 4RSA-10MQ | Cleco |
| | .2 - 4.5 | Straight | Lever Electric | CL-4000 | Jergens |
| | 2.5 - 21 | Straight | Lever Electric | CL-7000 | Jergens |
| 4 - 40 | 4 - 9 | Straight | One Shot Push to Start | 2B88A-1200F | Desoutter |
| | 2.5 - 21 | Straight | Lever Electric | CL-7000 | Jergens |
| 6 - 32 | 5 - 15 | Straight | One Shot | 16501AA7 | Gardner-Denver |
| | 2 - 17 | Straight | One Shot Lever | 4RSAL-17BQ | Cleco |
| | 11 - 40 | Straight | One Shot | LUM22SR016 | Atlas-Copco |
| 8 - 32 | 8 - 42 | Pistol | One Shot Electric | 64152 | Jergens |
| 10 - 32 | 11 - 40 | Pistol | One Shot | LUM22HR016 | Atlas-Copco |
| | 2 - 45 | Pistol | One Shot | 44RSAPT-7 | Cleco |
| 1/4 - 20 | 7 - 100 | Pistol | One Shot | CP3008-PRASKA | Chicago-Pneumatic |
| | 20 - 160 | Pistol | One Shot | 88RSAPT-5Q | Cleco |
| 5/16 inch | 20 - 160 | Pistol | One Shot | 88RSAPT-5Q | Cleco |
| | 168 - 312 | Angle | One Shot | 147NAL-6RA-12 | Cleco |
| | 108 - 300 | Angle | One Shot | CP3017-TADRUM | Chicago-Pneumatic |
| 3/8" | | | | | |
| | 50 - 288 | Pistol | Ratchet | 2T90P | Desoutter |
| | 50 - 288 | Straight | Ratchet | 2T90L | Desoutter |
| | 50 - 325 | Horizontal | Ratchet | URW-10N | URYU |

# Purchasing Information

- Cleco - Jergens - Atlas - Copco - URYU:

  Pneumatic Systems Inc.
  280 Pleasant St.
  Ashland, MA. 01721
  (617) 881-3855

- Chicago Pneumatic:

  PALMAC Co. Inc.
  72 South Avenue
  Natick, MA. 01760
  (617) 237-3550

- Desoutter:

  Kaminski Associates
  99 High Service Avenue
  North Providence, R.I. 02911
  (401) 353-1166

- Gardner-Denver:

  Pearse-Pearson Co. Inc.
  1370 Main Street
  Millis, MA. 02054
  (617) 376-2947

# APPENDIX A REFERENCED DOCUMENTS

## A.1 EL-Class Digital Documents

| EL-Class Number | Document Title |
|---|---|
| EL-00002-00 | *DEC STD 002-0 AC Power Wiring, Safety Earth Grounding, Plugs and Receptacle Information and Requirements* |
| EL-00119-00 | *DEC STD 119-0 Digital Product Safety - Introduction and General Requirements* |
| EL-00122-00 | *DEC STD 122-0 AC Power Line Standard: Design Requirements and Guidelines* |
| EL-MF328-00 | *Engineering Specification - General Torque Requirements* |

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# APPENDIX B RELATED DOCUMENTS

## B.1 Other Documents

| Document Number | Document Title |
|---|---|
| H950-0-0; H957-0-0 | *Option Configuration Drawings* |
| H9602-0-0; H9650-0-0 | *(Corporate Cabinets)* |
| H9642-0-0; H9645-0-0 | *System Configuration Drawings (Cross Product Cabinets)* |
| H9646-0-0; H9647-0-0 | *System Configuration Drawings (Cross Product Cabinets)* |
| H9652-0-0 | *(Corporate Cabinets)* |

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